GANs for Medical Image Synthesis: An Empirical Study

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Abstract

Generative adversarial networks (GANs) have become increasingly powerful, generating mind-blowing photorealistic images that mimic the content of datasets they have been trained to replicate. One recurrent theme in medical imaging, is whether GANs can also be as effective at generating workable medical data, as they are for generating realistic RGB images. In this paper, we perform a multi-GAN and multi-application study, to gauge the benefits of GANs in medical imaging. We tested various GAN architectures, from basic DCGAN to more sophisticated style-based GANs, on three medical imaging modalities and organs, namely: cardiac cine-MRI, liver CT, and RGB retina images. GANs were trained on well-known and widely utilized datasets, from which their FID scores were computed, to measure the visual acuity of their generated images. We further tested their usefulness by measuring the segmentation accuracy of a U-Net trained on these generated images and the original data. The results reveal that GANs are far from being equal, as some are ill-suited for medical imaging applications, while others performed much better. The top-performing GANs are capable of generating realistic-looking medical images by FID standards, that can fool trained experts in a visual Turing test and comply to some metrics. However, segmentation results suggest that no GAN is capable of reproducing the full richness of medical datasets.